PALAEOBOTANICAL EXAMINATIONS ON MANGANESE SERIES IN URKUT (HUNGARY, TRANSDANUBIA)

P. SIMONCSICS and M. KEDVES
Botanical Institute, University of Szeged

INTRODUCTION

The necessity of palaeobotanical examination of the manganese ore series in Urkut was raised by the result of the chemical studies reported by GRASSELLY and E. KLIVÉNYI [1960] in their preliminary publication. The theme promised to be interesting in respect of lacking publications of such examinations made in Hungary. The palynological research of this area is interesting from stratigraphic standpoint too, as the manganese series in Urkut originated from Upper Lias according to NOSZKY [1952], VADÁSZ [1952], SZABÓ-DRUBINA [1957] and CSEH NÉMET [1958], and a part of the beds was rearranged in period from Upper Jura to Middle Creta. In Hungarian relation the black coal bed in Komló originates from Lower Lias, its palynological examination was published by GÓCZÁN [1956].

In consequence of the examinations the following problems were arisen:

a) Is the origin of manganese series of Urkut from Upper Lias demonstrable on the basis of palynology?

b) Does the sporomorph spectrum show the rearrangement in Urkut?

c) Are there to be found some sporomorphs in Lower Liassic coal series of Mecsek (Komló) and in Upper Liassic manganese series of Urkut, which could be considered as common Jurassic, resp. Liassic characteristics, in spite of the differences existing between the developments and ages?

d) Does the manganese ore series include continental, shallow- or deep-sea, freshwater sediments?

To our mind the answer these questions will considerably contribute to the understanding of the chemical composition of the manganese ores, on the other hand to the palaeobotanical knowledge of the age in question respectively to the stratigraphy of the Hungarian Mesozoic era.

MATERIAL AND METHODS

We studied 47 samples on the whole, 17 out of them gave a total section, which is identical with the section worked up by *Grasselly* and *Cseh Németh* in his geological and mineralogical paper (Acta Miner. Petr. Szeged, 14, 1961). In our tables are the markings of the layers identical with the markings in paper of the above-mentioned authors. — The rest are single samples from the different part of the area. The samples were prepared by maceration in about 5 grams material. We began dissolve the manganese and decompose the carbonates by HCl and H_2O_2. After washing the samples were treated by the HNO_3, KOH and HF methods usually. The preparations were examined with oil immersion object glass, the photomicrographs were taken by 60× and 100× HI object glass and all are without retouch.

RESULTS

The samples containing the manganese and the loamy material with poor manganese contents are all rich in organic rests. All samples contain organic material in some form, but only few has sporomorphs in botanically well preserved condition. The intensive examination revealed abundant ensemble of microfossils.

The indicated microfossils, sporomorphs are discussed in succession of the natural system. In determination and identification of single sporomorphs we could not use the established nomenclature, as the Hungarian literature is deficient and the foreign literature has some different trends; therefore after identification we used the names given by the authors. We think it is the proper way lacking an established taxonomic procedure. Thus we don't deal with problems of nomenclature exceeding the limits of our work, though we shall refer to problems of nomenclature too, discussing the single forms.

SYSTEMATIC DESCRIPTION OF MICROFOSSILS

PROTOPHYTA

Cf. Algae **(Plate I., photos 1—8, Plate VIII. photos 21, 22).**

In some specimens rests are observable which are organisms without doubt but their origin is uncertain. We can distinguish 3 types:

a) Organism of spherical shape, about 6—8 μ in diameter, granular surface, size of the granules 0,7—1 μ, they are porelike formations, 2—4 μ in diameter. The observed specimens occur in groups always **(Plate I., photos 1—3 and 4—5).**

b) Organism, 5—8 μ sized, with irregular ornamentation, contour round or rounded ellipse. It was found in single granulae **(Plate I., photos 6—8).**

c) Spherical body, 10 μ sized, surface covered with numerous prickles (echinate), the base of the single prickle is wart-like, their length extends to 2 μ. This type presumably belongs to the *Hystrichosphaeridae* **(Plate VIII., photos 21—22).**

Hystrichosphaeridae

Specimens belonging to the *Hystrichosphaeridae* are to be found in small quantity in samples *a, b* of the rock-slope sections. We can distinguish two types on the basis of VALENSI's [1953] monography:

Micrhystridium recurvatum f. brevispinosa VAL. 1953 **(Plate I., photos 10—11 and 14, 15).**

Micrhystridium cf. *arachnoides* VAL. 1953 **(Plate I., photo 9).**

In DEFLANDRE's [1947] opinion *Micrhystridium* genus is to be found from Gotlandium to Creta, VALENSI [1953] found both genera in the Jurassic layers.

The oecology of the *Hystrichosphaeridae* can be pointed out as maritime or brack water environment according to the identical opinion of MATTHES [1956], BRELIE [1958], BRELIE and WOLTERS [1958], AVERDIECK [1958] and other authors. Their origin is uncertain, they can be ovules, planchtens, Dinoflagellatae, even spores.

Crassosphaeridae

These organisms were described by *Cookson* and *Manum* [1960] first. They published merely the new genus without establishing a separate category for this interesting and important group of microfossils. We consider the introduction of a new taxon is justified; their later systematization will be necessary, but on account of their deficient data we could not afford to accomplish it.

The relations of these microorganisms are uncertain, they are planchtons in all probability. In some samples one of the three differentiated species *Crassosphaera concinna* COOKSON and MANUM 1960 occurred consistently. The authors cited pointed out the difference between the *Tytthodiscus* NOREM 1955 and *Crassosphaera* COOKSON and MANUM 1960, i. e. the segmentation of the wall is characteristic of the former genus, while it does not occur in the latter one. We could not observe the segmentation in our specimens, so the determination of the genus is doubtless, but we hint at the fact, that the walls of our specimens are thinner than the walls observed by the above-mentioned authors. Moreover there are differences in some features between the Australian and Spitsbergean specimens according to COOKSON and MANUM [1960], in our opinion this is a reason for a new scheme of classification.. The forms examined are nearer to the Spitsbergean type.

Crassosphaera concinna COOKSON and MANUM 1960 **(Plate II., photos 1—6).**

Contour round or secondarily distorted, diameter 50—60 μ, surface densely covered with small projections, the pattern „resembling the cast of a honeycomb". In the centre of each projection these are little points, they are really the openings of the canals tending towards the centre, the wall is 3—4 μ thick.

Distribution: from the publication of COOKSON and MANUM [1960]: „Neocomian (on faunal evidence according to Island Exploration Co.'s Palaeontologist): Komenwu, Papua, New Guinea. I. E. C's well no 2 at 6840 ft. Lower Tertiary; Forlandsundet, Vestspitsbergen, 78° 40′ N—11°."

Stratigraphy: from Lias to Lower Tertiary.

Note: MACKO [1957] in his work compares the *Crassosphaera*-like microorganisms and the recent *Diatomeae.* Our specimen mostly resembles to the *Stephanopyxis fuscus* JOUSÉ, described by MACKO in Lower Miocen, but this is only an external similarity and in our opinion it is an inadequate method to identify a Mesozoic form with a recent species.

MYCOPHYTA

The identification of the examined specimens belonging to this category is not possible. Spores of different types **(Plate I., photo 16, 17, 21),** conidia **(Plate I., photo 18, Plate X., photo 6)** and hypha threads **(Plate I., photo 20, 22)** were found. It is to note, that some fungus rests occurred on disorganized higher plant rests (cuticula), consequently we can draw the conclusion, that there were parasitic or saprophitic vegetations. As the quantity of the fungi rests occurred in direct ratio with the plant rest, the possibility of secondary contamination may be excluded.

PTERIDOPHYTA

Lycopsida

Lycopodiumsporites clavatoides COUPER 1958 **(Plate III., photo 19 and Plate VI., photos 7–11).**

Spores trilete, laesurae not always distinct. Surface reticulate, size range of reticulum 4–15 μ, thickness of the ridges (muri) 0,5–2,5 μ, their length 5 μ maximum. Wall of the spores 1–2 μ thick, the wall-hyalin under the reticulate thickening is smooth or minulety chagrenate. Maximum diameter 35–50 μ, measured together with the height of the ridges.

The spores shown in the figures are similar to the spores of GÓCZÁN [1956], belonging to the *Lycopsida,* from Lias of Mecsek, which are similar to the forms of ROGALSKA [1954]. Our spores are in agreement with the Middle Jurassic sporeforms, published by COUPER [1958]. Otherwise COUPER [1958] points out, that the age of the spores is the period from Jura to Lower Creta.

Pteropsida
Schizaeaceae

Leiotriletes pflugi n. fsp. **(Plate III., photos 1,2; 3,4; 5,6; 7,8; 9; 12, 13).**

Diagnosis. In polar view rounded-triangular trilete spore. Laesurae of the tetrad scar long, but don't reach always the equatorial contour, r = $^4/_5 - ^5/_5$, exosporium 2–3 μ thick, chagrenate, intrapunctate or inragranulate. Striae-like structure is observable too, presumably in consequence of secondary transformation. Diameter 28–45 μ.

Holotype: **Plate III., photos 1,2.**

Stratigraphy: it is known only from the Lias.

The spores described under the above-mentioned denomination are in their different preservations like some fsp. of the *Poroplanites* genus of PFLUG [1953], regarding the triplanity. H. DEÁK [1959], and KEDVES [1960, 1961], in their publications dealing with the trilete, triplanoid and triplan shape-transformations pointer out, that the triplan, triplanoid forms are preservation states of the trilete spores. BOLKHOVITINA has the same opinion too (verbal information), moreover in her mind the trilete spores having lost their perisporia turn into triplans generally. Her opinion is based on numerous recent examinations. The fossil trilete forms and the triplans are contracted by many other authors too. KEDVES [1961] expressed his opinion in this regard minutely in his paper about the spores of the coal basin from Sparnacian stage of Dorog. Concerning the pores of the genus *Poroplanites* PFLUG 1953 we note, that neither we nor GÓCZÁN observed pores on these forms in Hungarian Lias. COUPER's [1955] opinion is, that the pores of these forms are differentiations in consequence of mechanical effects and in contrast with PFLUG [1953] he attaches no phylogenetic importance to these, moreover he considers impossible to admit the relationship of *Poroplanites* PFLUG 1953 to the *Angiospermae* or angiospermid. As our spores apart from the pores, are similar to *Poroplanites porosinuosus* PFLUG 1953, we denominate our forms *Leiotriletes pflugi,* expressing our appreciation to the excellent palynologist. Our forms are similar to REISSINGER's [1950] *„Vermutliche Farnspore"* called spores (Tafel XII., Fig. 14—16) and to some forms of GÓCZÁN's *„Farnspore Type 4/d"* and *„Farnspore Type 5"* from Lias of Komló.

We observed the following form variations within the form species:

Leiotriletes pflugi n. fsp. asp. *triplanoid* n. asp. **(Plate III., photos 3—4, 9).**

Diagnosis: slightly triplan spore, the size-difference of the axis is not significant.

Holotype: **Plate III., photos 3, 4.**

Note: The described specimen is very much like the spores placed by PFLUG [1953] in the *Poroplanites* (*P. porosinuosus* PFLUG 1953).

Leiotriletes pflugi n. fsp. fvar. *triplan* n. fvar. **(Plate III., photos 5, 6, 7, 8).**

Diagnosis: extremely concave in polar view, the pole-axis is longer than the equatorial axis. The three lobes are well observable in any case.

Holotype: **Plate III., photos 5, 6.**

Note: As this form frequently occurs, we suppose, that the further palynologic examinations of the Liassic age will enlarge the form-variations.

Affinity: Presumably *Schizaeaceae,* cf. *Lygodium.*

The **photos 12, 13 on Plate II.** represent strongly compressed specimens, such forms, which are varied, depending on the direction of the compression and which are not characteristic, we can not regard them as special form-variations.

Punctatisporites rotundus WEYLAND and GREIFELD 1953 **(Plate IV., photos 17, 19).**

We found it in one specimen with 47 μ diameter, the dehiscentia lines run to $^2/_3$ of the radius. Exosporium granular, wall 1,5—2 μ thick. WEYLAND and GREIFELD [1953] (in KREMP, AMES and HILDE GREBE [1957]) found the size 45 μ, but we think that the minimal difference between the size of the spores can not prevent the identification.

Stratigraphy: Lower Creta, Upper Senon according to the authors, Lias according to our examinations.

Affinity: It is not given by WEYLAND and GREIFELD [1953] (in KREMP, AMES and HILDE GREBE [1957]), but our observations on recent material justify the belonging to the mentioned family, but it is uncertain and for this reason we use as category cf. *Schizaeaceae.*

Trilites verrucatus COUPER 1953 f. *minor* n. f. **(Plate V., photos 5, 6; 7, 8; 9, 14).**

Description. Contour round or strongly rounded triangle in polar view. Laesurae of the tetrad scar are long, r = $^4/_5$—$^5/_5$, exosporium about 2 μ, sculptura verrucate, height of the warts here and there reaching 2 μ, the average 1 μ generally. The warts may form here and there pseudo-reticulum. The description of the spore published so far is in accordance with the *Trilites verrucatus* COUPER 1953, but the size of our spores doesn't reach the size given by COUPER [1953], i. e. 35—(42)—51 μ and so we consider it as a new form.

Diagnosis: 20—(25)—30 μ sized spores within the form species, which agree in sculpture and in other features with the diagnosis given by COUPER [1953] and respectively with our description followed partly COUPER's data.

Holotype: **Plate V., photos 5, 6.**

Stratigraphy: According to COUPER the fsp. originates from Creta and on the basis of the geological results our specimens are Jurassic (Lias). Maybe, that the difference between the data published by COUPER and our spores are showing a developement line, perhaps our small specimens are spores of the ancestral types of the fossile fern-species and the Cretaceous spores are more developed. Naturally the geographical difference can produce such variations and our above-mentioned supposition is obvious on the basis of morphological agreement and difference of the ages, but we don't regard this question as settled.

In COUPER's [1953] opinion the affinity is unknown but according to the available data no definite affinity can be proved, however, we suppose an affinity with the *Schizaeaceae.*

Punctatisporites fsp. **(Plate V., photo 13).**

Fragmentary form, surface punctate, here and there granulate, however it is doubtful whether the observed structure is original, or the result of the corrosion. Maximum diameter 32 μ, laesurae extending almost to the equator, shape streched ellipsoid, presumably owing to the compression.

In all probability the spores shown on the Plate V., photos 18—19, belong to this form-genus, but the laesurae are uncertain, the thickness of the

exosporium is about 1,5 μ, having intragranulate and rugulate structure, at any rate the secondariness of the structure holds good as in the former specimen.

Affinity on the basis of the preceedings presumably *Schizaeaceae.*

Cf. Gleicheniaceae

Undulatisporites fsp. **(Plate V., photos 11—12).**

Triangle spore, rounded in polar view, diameter 30 μ. Laesurae on the tetrad scar opened, so the features can not be well determined, nevertheless its vawy running is doubtless. Near the laesurae a torus-like formation is seen, this however may be secondary due to the deformation. Surface of the exosporium granulate, sculpture not well observable.

Affinity: presumably *Gleicheniaceae.*

Cyatheaceae

Cyathidites minor COUPER 1953 **(Plate IV., photos 9, 10).**

The observed specimen is maximum 38 μ, tetrahedric spore, equatorial contour rounded triangle, side-lines straight or slightly concave. Laesurae of the tetrad scar reaching almost the equator, there is a torus apparently, due to the opening of one laesura. Spore wall chagrenate, ornamented, thickness to 1,5 μ.

COUPER [1958] points out as affinity *Dicksoniaceae* besides *Cyatheaceae* and the distribution from Jura till Lower Creta in Englend.

Cyathidites minor COUPER 1953 asp. *triplanoid* n. asp. **(Plate III., photos 10, 11).**

Diagnosis. Laesurae straight, reaching the equator, with narrow margin. Thickness of the exosporium 1—1,5 μ, the wall obviously two-layered, internal spore-wall chagrenate. The form is compressed towards the triplanoid and the sidelines of the equatorial contour became convex.

Holotype: **Plate III., photos 10, 11.**

Affinity: As the spore is in all probability the triplanoid form of the *Cyathidites minor* COUPER 1953, it may be considered on the basis of the above-mentioned facts, as the *Cyatheaceae* or *Dicksoniaceae.*

Stratigraphy: in all probability corresponds to the *Cyathidites minor* COUPER 1953.

Sporites incertae sedis

Toroisporis transdanubicus n. fsp. **(Plate IV., photos 11, 12).**

Diagnosis. Equatorial diameter 35 μ, contour triangle with rounded vertices, straight or slightly concave sides. Laesurae don't reach the equator, r = $^4/_5$. The scar „Y" is associated with a narrow torus, maximum breadth 3 μ. Sporewall on the corner 2 μ, in the middle of the sidelines minimum 5 μ; they are two-layered on the corner and seems to be composed of more lamellae

in the middle of the sidelines. Ornaments of the lamellae are not distinct, structure not more rough than the chagrenate, however, the innermost lamella is punctate probably.

Holotype: **Plate IV., photos 11, 12.**

Stratigraphy: according to the last results only from Lias.

Distribution: manganese ore series in Urkut.

Note: The described new fsp. shows similarity to the fsp. of the *Toroisporis* (*Divitoroisporis* KRUTZSCH 1959) subfgen., published by KRUTZSCH [1959] from the Tertiary, but it differs by structure and size range of the exosporium, the gaping of the laesurae is absent or merely a „pseudodivisus" form is present.

We can consider the sporomorphs on the **Plate III., photos 16—18** belonging to this group too, but the thickening of the side-lines is here doubtful and the laesurae seem to reach the corners in consequence of the spore deformation. Therefore we designate them with cf.

Polycingulatisporites n. fgen.

Fgen, type: *Polycingulatisporites circulus* n. fsp.

Diagnosis: Contour round or rounded triangle. Two ± concentric rings appear on the spore in proximal view, in most cases with wavy or dented course. The laesurae of the tetrad scar are distinct in polar view.

Note: The new fgen. differs from the known fgen. of the *Zonotriletes* (WALTZ 1935) R. POT. and KRP. 1954., by interesting morphological features.

Polycingulatisporites circulus n. fsp. **(Plate VI., photos 1—6).**

Diagnose: Spore round or ellipsoid. Maximum diameter 35—50 μ. The external zone 3—5 μ broad in proximal view, surface striate minutely, the structure elements are arranged in radial direction. The dividing line between the external and internal zone wavy, striate like the former, however, the structure is here not so distinct. The central body is nearly a rounded triangle with a smooth surface. The laesurae of the tetrad scar may be slightly wavy and enter in to the external zone, then bifurcate forming an obtuse angle. Distal pole smooth, but the characteristic structure in form of concentric rings is well observable.

Holotype: **Plate VI., photos 1—6.**

Note: Our form described above is so characteristic of and different from the known spores of the *Zonales* (B. and K. 1886) R. POT. and KRP. 1954., that we wish to raise some questions concerning their morphology. As in *Cingulatisporites* TH. 1953., *Polypodiaceoisporites* R. POT. 1956, non 1951, in *Camerozonosporites* PANT 1954 and in other formgenera the zones are always well definable and well separated from the central body, so we cannot say the same about our new formgenus. The zonal morpohology of the external sphere seems to be doubtless, but doubts may arise concerning the internal zone as the real spore — the central body is of minimal size related to the whole of the form. Therefore it is presumable that the central body is separated into two parts inside the zone. This possibility is not out of question, at any rate the concept mentioned above seems to be reasonable at least on the basis of the data available in the literature. We hope the following examinations will contribute further informations to the knowledge of this very interesting spore.

Perotrilites pseudoreticulatus COUPER 1953 **(Plate V., photos 1–4).**

Well preserved specimen, its morphology is suitable for exact examination on proximal and distal poles. Diameter 35 μ, on the proximal pole ornamented with minute, irregular, not reticulate sculpture elements, the prominences are stronger and more distinct on the distal pole. The ridges 1 μ broad, 1,5–2 μ high. Wall thicker than 1 μ. Laesurae of the tetrad scar slightly wavy in polar view reaching almost the equator, r=4/5.

Stratigraphy: Jura in opinion of author.

Affinity: uncertain.

Corrugatisporites arcuatus WEYLAND and GREIFELD **(Plate V., photos 16, 17).**

The spore is fairly compressed and fragmentary specimen, however the essential features are well recognizable with oil-immersion object glass. Size 45 μ, somewhat smaller than measured by the above-mentioned author, contour ellipsoid, secondarily altered in consequence of compression. Laesurae reach the equatorial contour, though this in not always to be seen on account of the secondary alteration. Sculpture corrugate, respectively verrucate, sculpture elements 2 μ maximum.

Stratigraphy: Lower Creta, Upper Senon according to the authors.

Affinity: unknown.

Leiotriletes fsp. **(Plate III., photos 14, 15).**

Spore trilete, diameter 28 µ maximum, equatorial contour rounded triangle, little compressed distal pole hinders the exact determination of the spore. Spore-wall two-layered, the layers are a little thinner than 1 μ, laesurae reach about the equator.

Cyatheacidites fsp. **(Plate V., photos 10, 15).**

Fragmentary specimen, zone with expressed wavy contour and sculpture. Height of the sculpture elements may reach 3 μ, breadth 2–5 μ. The central body seems to be smooth and has poor structure, diameter about 25 μ, laesurae of the tetrad scar are clearly observable and run to the margin of the central body. Diameter maximum 32 μ.

In the following part we describe spores of unknown, or uncertain form-genera.

Pteropsida spore indet., *type „A"* **(Plate IV., photos 1, 2).**

Diameter 32 μ, in polar view triangle. Tetrad scar obscure, however its presence is sure. It has a charasteristic formation on the corners, which reminds in some features of the Obtusi-apparate (PFLUG 1953), though does not quite correspond to it. It is interesting and possible that this form will later have great importance in phylogenetic point of view, because a formation is visible on the corners, bearing resemblance to the germinal apparate of the *Angiospermae*'s pollen. As this formation is obscure, we attach no importance to it, but possibly we shall be able to observe later the primitive type of the ancestral

Angiospermae pollen in well preserved material. The spores shown on **Plate IV., photos 3, 4 and 5, 6** belong presumably to the same type, though the obscure germinalia on the latter photos are not to be seen.

Pteropsida spore indet., *type „B"* **(Plate IV., photos 7, 8).**

Equatorial diameter maximum 27 μ. Equatorial contour triangle with obtuse angle. Exosporium about 1 μ thick, chagrenate. Laesurae of the tetrad scar reach the vertices. Spore shows similarity to the *Cyathidites minor* COUPER 1953, but is smaller and granulated more minutely. The form on **Plate IV., photos 15, 16 and 18** belongs to the same category, but the walls are little stronger.

Pteropsida spore indet., *type „C"* **(Plate IV., photos 13, 14).**

Maximum size 30 μ. Equatorial contour rounded triangle in polar view. Laesurae obscure, reaching almost the equator. Spore wall thicker than 2 μ, ornamentation intrapunctate or intragranulate, not determinable exactly.

Cf. Pteridophyta spore **(Plate V., photo 20).**

Few specimens of diameter 70 μ maximum, not well preserved for exact determination; the form reminds of spore, the adherent opaque material does not shade the coarsely granulated surface. Uncertain remains like our specimens: *Sporites macroserratus simplex Wolff* 1934 (in KREMP, AMES and KOVAR [1958]), and the specimen denominated *„Siegelsum R-type"* by PFLUG [1953].

GYMNOSPERMAE

Pteriodspermae

Caytoniales

Caytonipollenites pallidus (REISSINGER) COUPER 1958 **(Plate I. photos 26, 27).**

Pollen with air-bladder, found in one specimen, wall very thin, body elongated, sculpture of air-bladder reticulate minutely.

Affinity: in all probability *Caytoniales;* REISSINGER describes [1950] it as *Pityosporites pallidus* and in his opinion is similar to *Podocarpaceae.*

Stratigraphy: from Jura to Lower Creta according to COUPER [1958].

Pteruchipollenites cf. *thomasii* COUPER 1958 **(Plate X., photos 1, 4).**

The observed specimen is strongly fragmentary, size maximum 35—40 μ, the body is surrounded by air-bladders halfmoon like. We note in connection with the structure, that its exact determination is impossible being distorted strongly.

Cycadinae v. Ginkgoinae

Monosulcites minimus COOKSON 1947 ex *Couper* 1958 **(Plate VII. photos 1—21).**

This pollen is frequent in Jurassic, generally in Mesozoic layers, it was found in numerous layers, e. g.: LANTZ [1958 a, b], COUPER [1958], GROOT

and PENNY [1960], etc. Similar forms are *Encephalarites cycadioides* ZAKLINSKAJA 1957 (pollen) described by ZAKLINSKAJA [1957] (in KREMP, AMES and KOVAR [1958]) and *Ginkgo bilobaeformis* ZAKLINSKAJA 1957 (pollen) too. KEDVES [1961] in his work regarding the pollen of *Ginkgo biloba* L. deals with this problem minutely, we refer here to some important data: LANTZ [1958] compared the *M. minimus* COOKSON [1947] ex COUPER [1958] with the pollen of cf. *Ginkgo biloba* L., named in the work of ROGALSKA [1957]. The observed fossil forms compared with the pollens of the recent *Ginkgo biloba* and the different genera of *Cycadinae,* the affinity with the *Cycadinae* is more likely, though the affinity with the *Ginkgoinae* can not be excluded, all the more as the problem of the systematic affinity of the Mesozoic pollens is to be carefully treated.

The observed specimens are 21—34 μ long, sulcus (colpus) assymmetrical, ectexine 1—1,2 μ, smooth, but we found intrapunctate, resp. intragranulate specimens too. These slight structural differences cannot be considered as essential features, partly owing to the observations made on the recent *(Ginkgo biloba* L., *Cycadinae)* pollens, partly owing to the secondary alteration, often observed in our examinations on fossil material.

Monosulcites urkutiensis n. fsp. **(Plate VII., photos 24—27).**

Diagnosis: Yellow or yellow-brown, ellipse-shaped pollen. Length 18—20 μ, ectexine 1—1,5 μ, surface chagrenate minutely. Sulcus does not reach the two apices of the pollen and often shows gaping.

Note. It differs by the small size and the smooth or slightly structured surface from the morphological related *M. minor* KEDVES 1961, *M. tranquillus* (R. POT.) TH. and PF. 1953, *M. zievelensis* PF. 1953 and *M. minimus* COOKSON 1947 ex COUPER 1958.

Affinity: problematical, presumably *Cycadinae,* but the different taxons of the *Monocotyledones* can not be left out of question.

Within the fsp. two subfsp. can be separated:

a) subfsp. *hyalinoides n. subfsp.* **(Plate VII., photos 24—26).**

Diagnosis: ectexine hyalin smooth, thickness 1 μ, sulcus does not reach the apices generally.

Holotype: **Plate VII., photos 24, 25.**

b) subfsp. *scabratus* n. subfsp. **(Plate VII., photo 27).**

Diagnosis: ectexine chagrenate, thickness 1—1,5 μ, sulcus reaches the two apices generally.

Holotype: **Plate VII., photo 27.**

Cf. Coniferae

Classopollis torosus (REISSINGER) COUPER 1958 **(Plate IX., photo 1—25.)**

Flattened, spherical pollen, sometimes impressed on the poles, obscure tetrad scar on the proximal pole, pore on the distal pole not always discernible. The general feature of the pollen is a characteristic zone around the equator, which consists of 4—8 striae, breadth of the zone 5—10 μ. The pollen-wall on other places is intrabaculate generally, but the baculae are here and there arranged in bands, forming zones, even the bands in equator are dissolved in some places,

forming inward standing baculae, which phenomenon presumably depends on the state of preservation.

Polar axis of the pollen 20—25 μ, equatorial diameter 26—40 μ. Exine composed of many lamellae. The lamella „a" of the ectexine is smooth, the lamella „b" is baculate, the external one is smooth. Baculae are smaller than 1 μ.

The surface of the pollen becomes „wrinkled" here and there, reminiscent of the colpi or cavernae, even geniculuslike differentiation may be formed.

We saw them in large quantities in sample no. 3. On the basis of the examinations of many specimens we agree with COUPER [1958] in the opinion, that PFLUG [1953] described variants of the same plant using different terms. The uncertainty of the above-mentioned determination — it is essentially adequate to the described species — and the diversity of formvariations of the found sporomorphs makes possible the differentiation of the sporomorphs, however we are convinced, that the pollens in question belong to a single species.

Affinity: uncertain in COUPER's opinion [1958], KENDALL's supposition, that the pollen belongs to the Araucariaceae is not proved, neither on the basis of the pollen-analyse, nor on the basis of the epidermis-studies of *Pagiophyllum connivens* KENDALL (Middle Jurassic plant, to which this pollen belongs). That it belongs to the *Coniferae* is likely, although THIERGART [1949] describes similar form as *Bennettites* pollenites.

Stratigraphy: According to COUPER's [1958] examinations it occurs from Jura to Lower Creta in England, PFLUG [1953] described the synonym *Classopollis classoides* PFLUG, the *Circumpollis phariseus* PFLUG 1953 and the *C. philosophus* PFLUG 1953 from the Lias of Siegelsum, the *Classopollis declassus* PFLUG 1953 from Lias of Wehmingen, the *Classopollis maturus* PFLUG 1953 from Lower Senon of Quedlinburg.

Coniferae

?? Taxaceae

Spheripollenites subgranulatus COUPER 1958 **(Plate VII., photos 28—39, Plate VIII., photos 1—15).**

These pollens could be well examined in our material, as they occurred abundantly in our samples, rich in pollens. Our forms are in full-agreement with the diagnosis, described by COUPER [1958], the porus hardly differentiable, is well discernible in some of our specimens. Sometimes they occur in groups **(Plate VII., photo 36),** or they are stuck together in pairs **(Plate VII. photos 37—39).** The structure is less observable in some cases on fragmentary specimens. Regarding their systematical affinities COUPER [1958] ranges it in the group Incertae Sedis and he supposes only the possibility of an affinity with the *Taxaceae.* On the basis of our present knowledge they belong probably to the *Gymnospermae,* but their closer affinity is unknown.

The case is similar to the *Spheripollenites* scabratus COOKSON 1958 **(Plate VIII., photos 16, 23),** described by COOKSON [1958], well differentiable due to its structure and greater size.

Uncertain affinities have the *Inaperturopollenites parvoglobulus* WEYLAND and GREIFELD 1953, described by *Weyland* and *Greifeld* [1953] (in KREMP, AMES and HILDE GREBE [1957]) **(Plate VIII., photos 25 and 31—37)** and the

I. globulus WEYLAND and GREIFELD 1953 **(Plate VIII., photos 38, 39).** They are interesting forms, whose belonging to the Pteridophyta can not be regarded as out of question, however their belonging to the Pollenites, according to the authors, is more likely. Theier relatively strong structure is characteristic of the ectexine and for that reason its identification as *Coniferae* is uncertain. We can not take sides definitely in this question as the literature is deficient and we could not examine these forms thoroughly, on account of their infrequent occurence.

ANGIOSPERMAE

Eucomiidites troedssonii ERDTMAN ex COUPER 1958. **(Plate VIII., photos 17, 18.)**

COUPER [1958] measures the polar diameter 28—(35)—42 μ, our pollen observed has 25 μ diameter. As other features entirely agree with the described froms, so the identification is without doubt. Its presence is very interesting, it originates probably from ancestral *Angiospermae* pollen, in ERDTMAN's opinion.

We observed some specimens of pollens of higher *Angiospermae,* which were inwashed or rearranged certainly and belong to this class in all probability. We list them too for the sake of completion.

Cf. Nymphaeaceae

Pollenites pseudohirsutus DOKT.-HREBNICKA ex PACLTOVÁ 1960 **(Plate VIII., photos 26—29).** The observed specimens have 16—18 μ diameter, surface ornamented with narrow, about 1,5—2 μ long prickles, thickness of the exine under 1 μ generally.

Cf. Ranunculaceae pollen **(Plate VIII., photos 24, 30).** Diameter 15 μ, nearly spherical pollen, surface ornamented densely with 2—2,5 μ prickles (echinate), which are broadened on their basis (2—3 μ).

Magnoliaceae

Monocolpopollenites indet. **(Plate X., photos 7, 8).**

67 μ long ellipsoid pollen. Sulcus (colpus) hardly observable, assymmetrical, perhaps by secondary alternation in consequence of fossilization. Surface structured, not well observable owing to the corrosion and contamination, but it is ornamented, intragranulate, intrarugulate, respectively as we were able to observe in spite of the hindering factors.

Cf. Compositae pollen **(Plate I., photos 23—25).**

We observed only one fragmentary specimen, which originates from a plant belonging doubtlessly to the *Compositae* according to ERDTMAN [1952], WANG [1960] and STIX [1960]. Regarding the age of our samples the specimen is undoubtedly allochton, possibly it is subfossil (recent) contamination.

Fagaceae

Tricolporopollenites cingulum (R. POT.) TH. and PF. 1953 subsp. *pusillus* (R. POT.) TH. and PF. 1953, *Tricolporopollenites cingulum* (R. POT.) TH. and PF. subsp. oviformis (R. POT.) TH. and PF. **(Plate VIII., photos 19, resp. 20).** Both forms are in affinity with the recent *Castanea* genus, their abundant presence begins in Lower Tertiary, it is a rearranged form too, inwashed from Lower Eocen probably.

Monosulcites indet. **(Plate VII., photos 22, 23).**

Only one specimen observed, length 23 μ, sulcus not to be seen well, surface granulate, resp. rugulate. This structure is characteristic rather of the *Palmae* pollens. It is to note here, that the presence of the *Palmae* in Jura is doubtful, but the occurrence of this pollen may be explained with the rearrangement, described by SZABÓ—DRUBINA [1957] and CSEH NÉMETH [1958], authors mentioned in the introduction of our work. It is of interest to note, that PACLTOVÁ [1961] indicates *Palmae* pollens in Senon, which determinations are right, being about 130 recent *Palmae* pollens identified according our observations and so the presence of the *Palmae* in Upper Creta is presumable.

Tissue fragments.

The tissue fragments are frequent both in the loamy and in the manganese ore containing samples. There are to be found parenchyme **(Plate X., photo 2)**, tracheide **(Plate X., photo 3)**, cuticular **(Plate X., photo 6)**, epidermoid **(Plate X., photo 9)** fragments, fossil tissue elements of high developed vascular plants. The determination of the plants is impossible on account of the deficient characteristics, but their presence is important owing to the carbon, phosphorus and sulfur content of the manganese ore.

Artificial products **(Plate I., photos 12, 13).**

In the preparations there are pretty frequently green-yellow little balls of different size with irregularly dispersed pores on their surface reminiscent of *Algae*. They can be experimentally produced from glycerine and aceton film solution and they adsorb the colouring agent of the sample. The cell group shown on **Plate I., photo 19** bears resemblance to them, but can not be considered to be artificial product; it seems to be composed of different individuals of smooth surface, like zooglea, their preservation in our opinion is due to their adhering to one, even to two cuticles.

DISCUSSION

On the basis of our investigations we can not give definitive answer to the raised problems in every respect. The reason is not the imperfection of the methods, but merely the fact, that out of the 45 samples only two were valuable for palynological examinations. Some useful conclusions can be drawn from

the spectrum **(fig. 1)** of samples deriving from the baring and from the oppermost layer of the bed.

a) Regarding their age we could determine on the basis of the stratigraphic statements of COUPER [1958], PFLUG [1953], WEYLAND and GREIFELD [1953] (in KREMP, AMES and HILDE GREBE [1957]) etc.'s statements stements, that our sporomorphs existed in England and Germany from Lias to Lower Creta. We found but few pollens (see *Angiospermae)* typical in Tertiary and which does not fit into the Liassic — Lower Cretaceous spectrum. We referred previously, in connection with the *Compositae* pollen to the probability of their origin from the subsequent contamination.

According to the present data the *Crassosphaera concinna* COOKSON and MANUM 1960 found in Spitsbergean Tertiary, is unfitting into the age, though *Crassosphaerae* are known in the Neocom too. The *Crassosphaera* genus was discovered in our days, its stratigraphy — as our data prove — surpasses the short time and space described by COOKSON and MANUM (1960) and their distribution was general from Ney Guinea to Spitsbergen, according to the present records.

Most of our forms prove the age to be from Lias to Lower Creta but they don't suggest a shorter period.

b) From the sporomorph ensemble described above, may be drawn such a conclusion that gives the answer to our second problem referring to the rearrangement of the layers. In so far as we found merely few sporomorphs inadequate to the Mesozoic in the barring and the uppermost samples of the layer, we have to ascertain, that the upper limits of the rearrangement did not pass the bed, respectively the Lower Creta.

The used literature locates most of the forms in Lias, resp. Lower Creta: by reason of the two spectra we could separate neither Lias, nor Dogger, nor Lower Creta; we must be confined merely to the negation of an age, which was older than Lias and younger than Lower Creta.

c) As the stratigraphy of the sporomorphs ranges in large intervals, many of our forms agree with the forms opened up from Liassic hard coal in Mecsek. GÓCZÁN [1956] disposed of less literature than we do now, therefore he named his form with a „nomenclature" of his own. We think it is not competent to draw comparison between the sporomorphs of Lias in Mecsek and of Upper Lias — Lower Creta in Urkut making use of the photos of many fairly corroded specimens. Some identity is shown in the following table:

Urkut	Mecsek
Lycopodiumsporites clavatoides COUPER 1958	*Lycopodites sp. (=Reticulatisporites sp.) (1 type)*
Cyathidites minor COUPER 1953	*Phlebopteris münsteri* (SCHENK) HIRM. et HOERH. *(4 type)*
Leiotriletes pflugi n. fsp.	*Farnspore (4/d type)*
Spheripollenites subgranulatus COUPER 1958	*Sporites* sp. *(13 type)*
Caytonipollenites pallidus (REISSINGER) COUPER 1958	*Pityosporites pallidus* (REISSINGER) *(Podocarpaceae?) (16 type)*
Pteruchipollenites cf. thomasi COUPER 1958	*Pinus haploxylon* RUDOLF

Naturally the Lias in Mecsek is more abundant in sporomorphs than the two samples of the manganese ore layers in Urkut, but the oecological conditions must have been different in the region, where the hard coal of Mecsek developed, as in Urkut.

d) Regarding the great variety of species, the *Pteridophyta* is firstly to be mentioned among the identified sporomorphs. Considering quantitative data, *Spermatophytae* are prevalent. They all are of continental origin. There are, however three forms (in both samples), all indicating — besides many continental forms — the sea-sediment origin of both samples. These are: *Micrhystridium recurvatum* f. *brevispinosa* VAL. 1955 and *M.* cf. *arachnoides* VAL. 1955. In the authors opinion both are Jurassic rests, characteristic of maritime sediments. The third form *Crassosphaera concinna* COOKSON and MANUM 1960 is also of maritime origin. In spite of the insignificant quantity the conclusion can be drawn, that the samples *a* and *b* originate from sea-, or half-salt water sediment, the spores and pollens were transported from a short distance, by water or air-way. We suppose the parent plants lived on sea-shore, which shed their pollens and spores into the sea, where they were fossilized in good condition, cut of from the atmospheric oxygen. In our samples few forms occurred in corroded condition, which fact contradicts the long transport.

Conclusively our samples *a* and *b* originate from shallow sea and coastal sediment.

e) The table *(fig. 1)* shows each sample contains organic material in some form. This refers to the samples taken from different parts of the layer and are not included in the table. We mentioned above, the samples with predominant manganese ore contain few pollens (or are free of pollens), but contain fraquently tissue fragments and amorphous organic rests.

SUMMARY

1) We examined by microscop 47 samples in all from manganese ore series of Urkut, 17 of them form a complete section.

2) Each sample examined contains organic material in some form.

3) Rich in sporomorphs are only the samples *a* and *b*. We described 17 spores and 17 pollens from both samples, besides 2 new spores and 1 new pollen fsp.

4) The result of quantitative analysis of two samples rich in pollens indicates sea-shore or mixed salt-water sediment.

5) In consequence of the deficient palynologic data the period from Upper Lias to Lower Creta can be considered as geological age by reason of sporomorphous spectrum.

6) As far as possible we identified some sporomorphs from Liassic spectrum of Komló described by GÓCZÁN (1956).

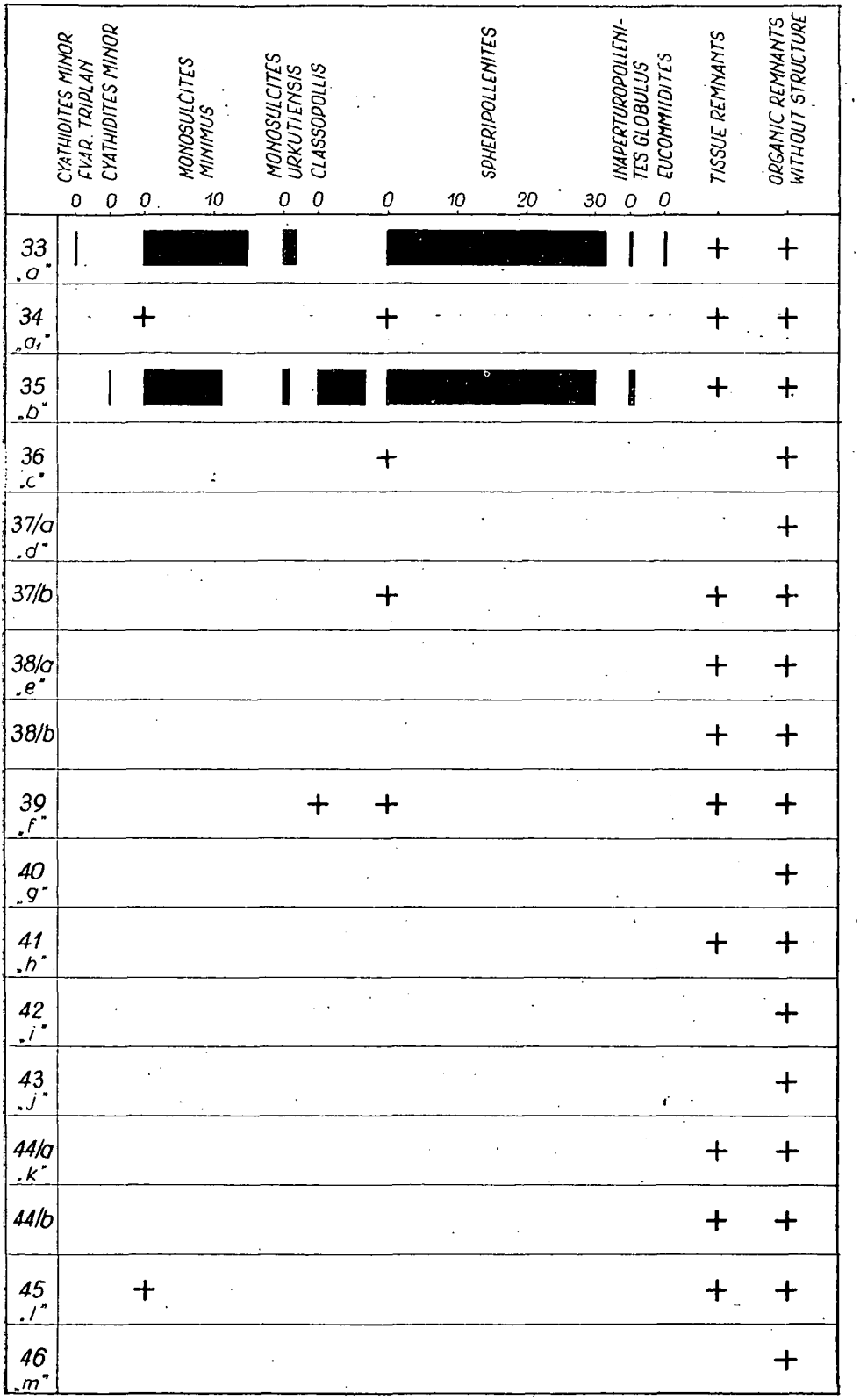
CYATHIDITES MINOR FVAR. TRIPLAN
CYATHIDITES MINOR
MONOSULCITES MINIMUS
MONOSULCITES URKUTIENSIS
CLASSOPOLLIS
SPHERIPOLLENITES
INAPERTUROPOLLENITES GLOBULUS
EUCOMMIIDITES
TISSUE REMNANTS
ORGANIC REMNANTS WITHOUT STRUCTURE
0 0 0 10 0 0 0 10 20 30 0 0
33 „a"
34 „a,"
35 „b"
36 „c"
37/a „d"
37/b
38/a „e"
38/b
39 „f"
40 „g"
41 „h"
42 „i"
43 „j"
44/a „k"
44/b
45 „l"
46 „m"

Fig. 1.

Explanation of Plates.

Plate I.

1—3. Cf. Algae
4—5. Cf. Algae
6—8. Cf. Algae
9. Micrhystridium cf. arachnoides *Val.* 1955
10—11. Micrhystridium recurvatum *Val.* 1955
12—13. Artificial product
14—15. Micrhystridium recurvatum *Val.* 1955
16. Mycophyta spore
17. Mycophyta spore
18. Mycophyta conidium
19. Cf. Algae, perhaps arteficial product
20, 22. Mycophyta, hypha
21. Mycophyta spore
23—25. Inwashed Compositae pollen
26—27. Caytonipollenites pallidus (REISSINGER) COUPER 1958

Plate II.

1—2. Crassosphaera concinna COOKSON and MANUM 1960
3—4. Crassosphaera concinna COOKSON and MANUM 1960
5—6. Crassosphaera concinna COOKSON and MANUM 1960

Plate III.

1—2. Leiotriletes pflugi n. fsp.
3—4. Leiotriletes pflugi n. fsp. asp. triplanoid n. asp.
5—6. Leiotriletes pflugi n. fsp. fvar. triplan n. fvar.
7—8. Leiotriletes pflugi n. fsp. fvar. triplan. n. fvar.
9. Leiotriletes pflugi n. fsp. asp. triplanoid n. asp.
10—11. Cyathidites minor COUPER 1953 asp. triplanoid n. asp.
12—13. Leiotriletes pflugi n. fsp.
14—15. Leiotriletes fsp.
16—18. Toroisporis cf. transdanubicus n. fsp.
19. Lycopodiumsporites clavatoides COUPER 1958

Plate IV.

1—2. Pteropsida, spora indeter., Type „A"
3—4. Pteropsida, spora indeter., Type „A"
5—6. Pterospida, spora indeter., Type „A"
7—8. Pteropsida, spora indeter., Type „B"
9—10. Cyathidites minor COUPER 1953
11—12. Toroisporis transdanubicus n. fsp.
13—14. Pteropsida, spora indeter., Type „B"
15, 16, 18. Pteropsida spora indeter., Type „B"
17, 19. Punctatisporites rotundus WEYLAND and GREIFELD 1953

Plate V.

1—4. Perotrilites pseudoreticulatus COUPER 1953
5—9. 14. Trilites verrucatus COUPER 1953 f. minor n. f.
10, 15. Cyatheacidites fsp.
11—12. Undulatisporites fsp.
13. Punctatisporites fsp.
16—17. Corrugatisporites arcuatus WEYLAND and GREIFELD 1953
18—19. Punctatisporites fsp.
20. Cf. Pteridophyta spore.

Plate VI.

1—6. Polycingulatisporites circulus n. fgen. et fsp.
7—11. Lycopodiumsporites clavatoides COUPER 1958

Plate VII.

1—21. Monosulcites minimus COOKSON 1947 ex COUPER 1958
22—23. Monosulcites indet.
24—26. Monosulcites urkutiensis n. fsp. subfsp. hyalinoides n. subfsp.
27. Monosulcites urkutiensis n. fsp. subfsp. scabratus n. subfsp.
28—39. Spheripollenites subgranulatus COUPER 1958

Plate VIII.

1—15. Spheripollenites subgranulatus COUPER 1958
16, 23. Spheripollenites scabratus COOKSON 1958
17—18. Eucommiidites troedssonii ERDTMAN
19. Tricolporopollenites cingulum (R. POT.) TH. and PF. subsp. pusillus (R. POT.) TH. and PF.
20. Tricolporopollenites cingulum (R. POT.) TH. and PF. subsp. oviformis (R. POT.) TH. and PF.
21—22. Cf. Algae
26—29. Pollenites pseudohirsutus DOKT.-HREBNICKA ex PACLTOVÁ 1960
24, 30. Cf. Ranunculaceae
25, 31—37. Inaperturopollenites parvoglobulus WEYLAND and GREIFELD 1953
38, 39. Inaperturopollenites globulus WEYLAND and GREIFELD 1953

Plate IX.

1—25. Classopollis torosus (REISSINGER) COUPER

Plate X.

1, 4. Pteruchipollenites cf. thomasii COUPER 1958
2, 5. Parenchymatous tissue fragment
3. Tracheide fragment with bordered pits
6. Mycophyta conidium cuticle adhering
7—8. Monocolpopollenites fsp.
9. Epiderm (cuticle)

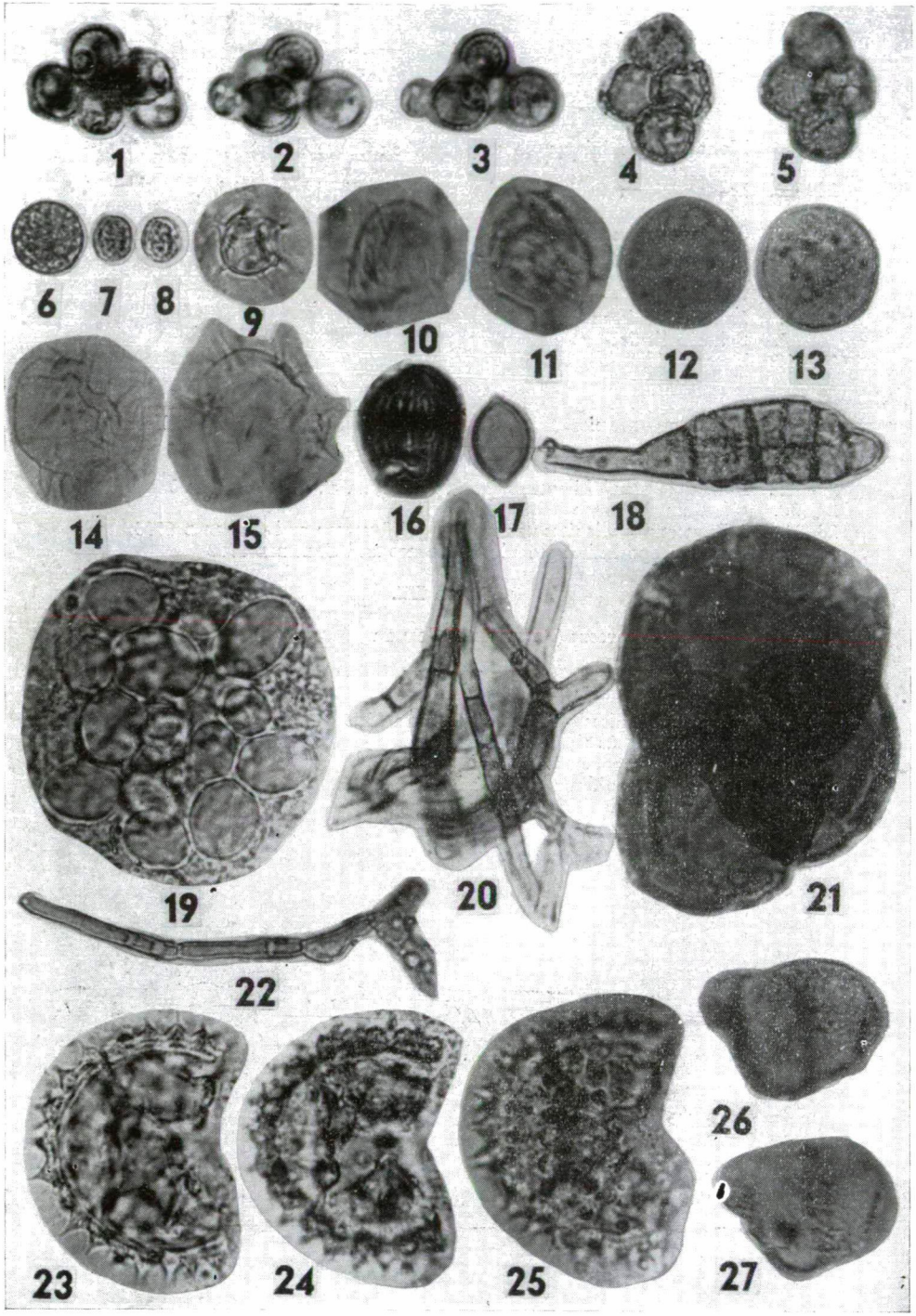
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27

Plate II.

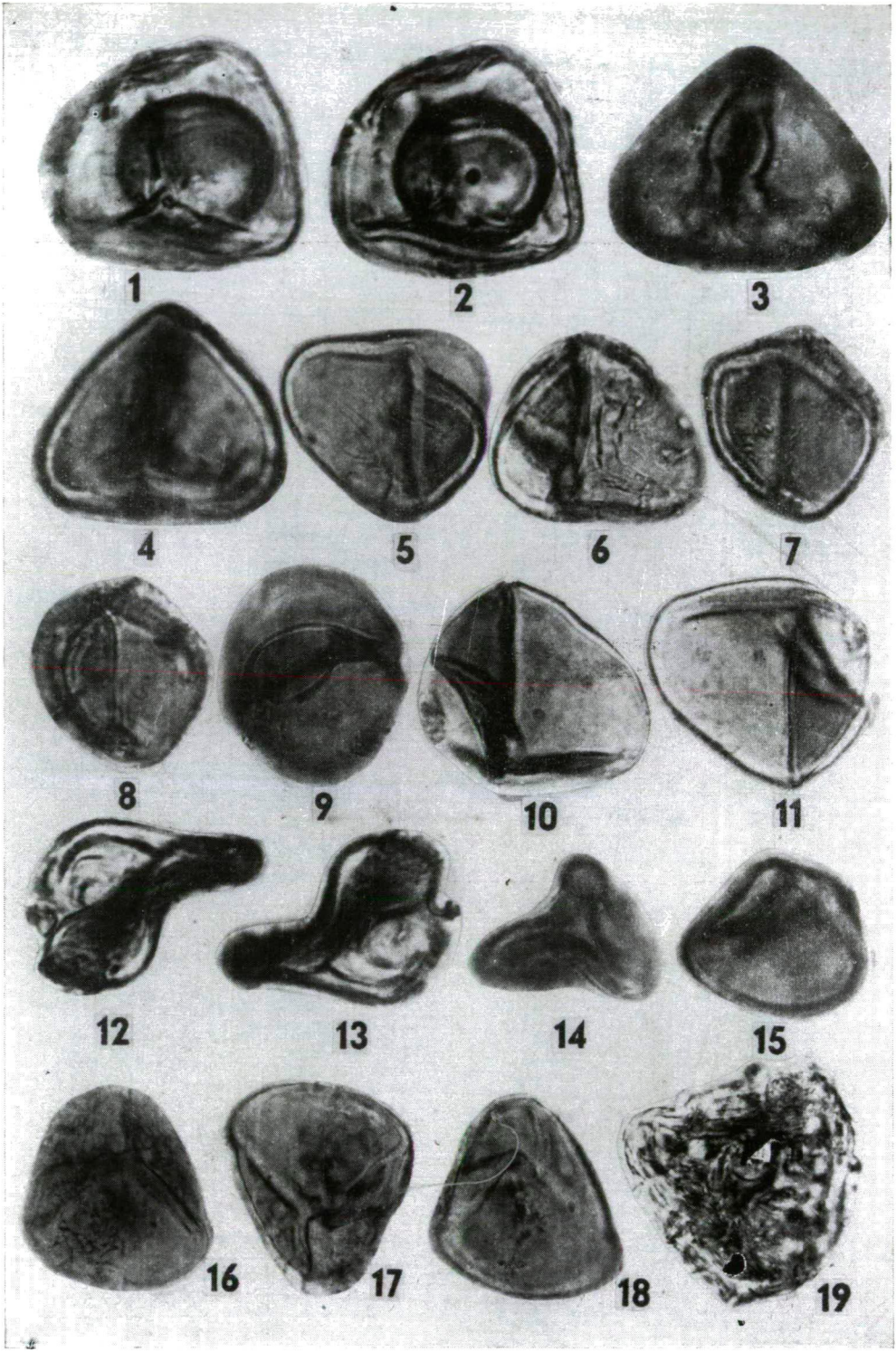

Plate III.

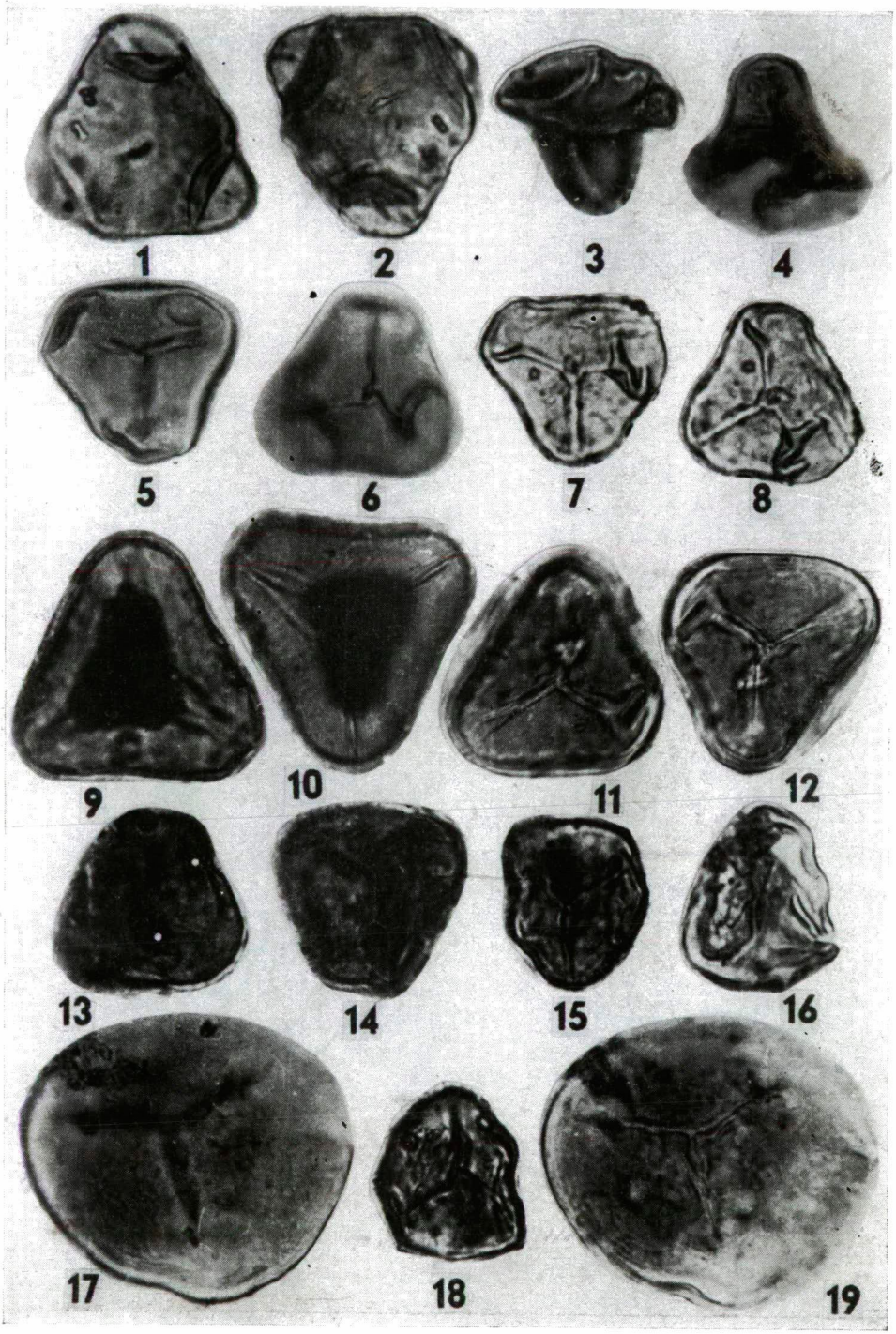

Plate IV.

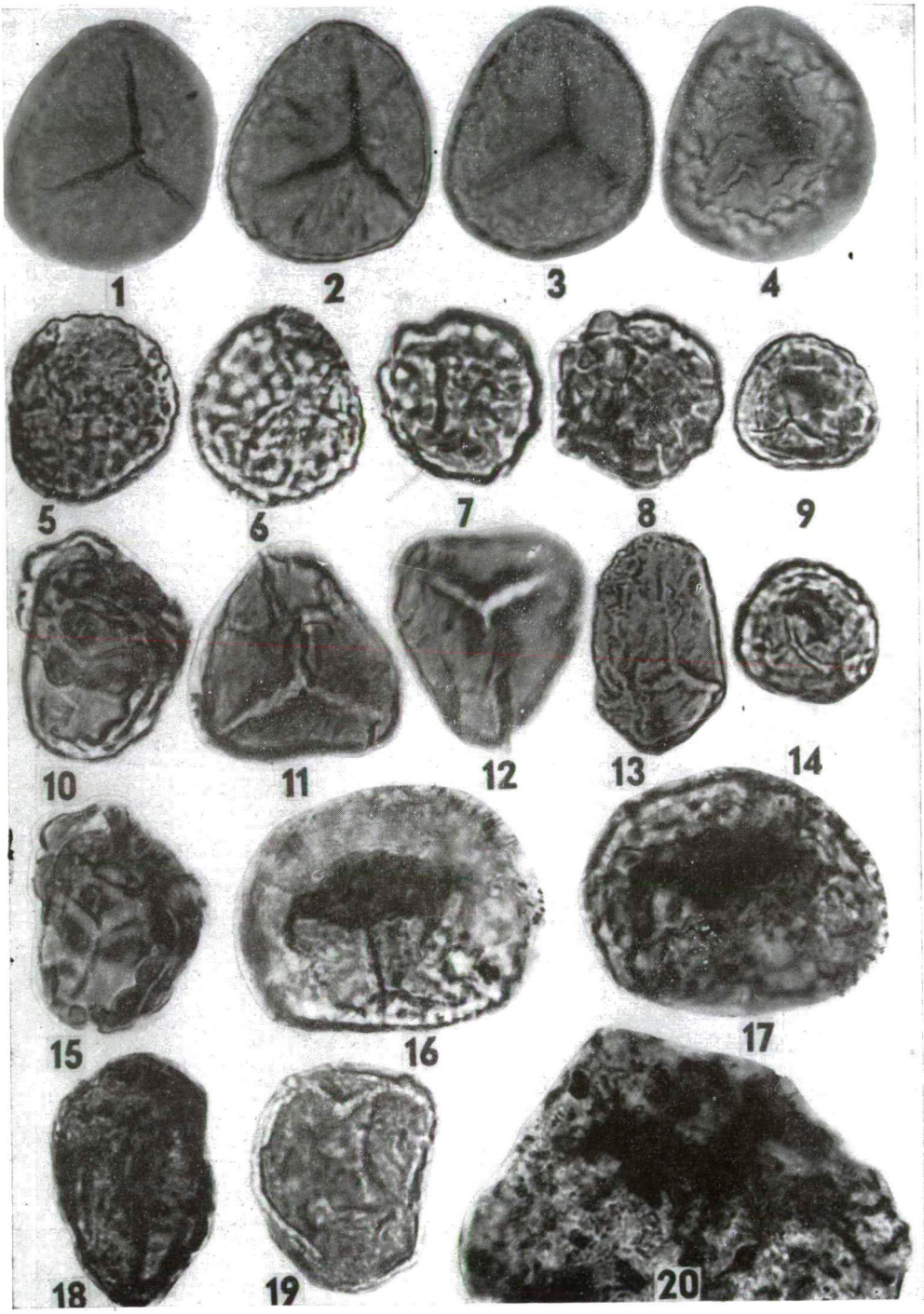

Plate V.

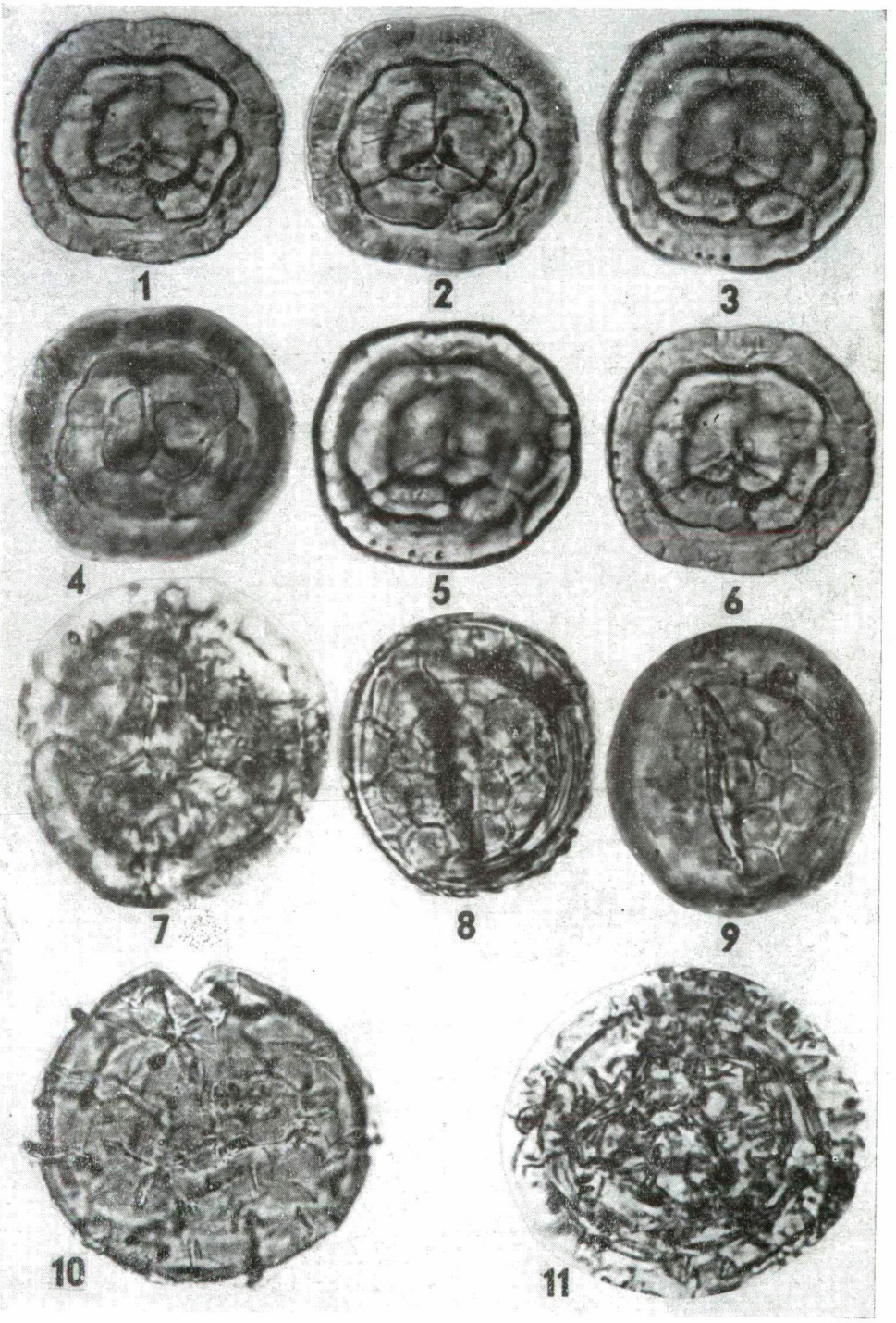

Plate VI.

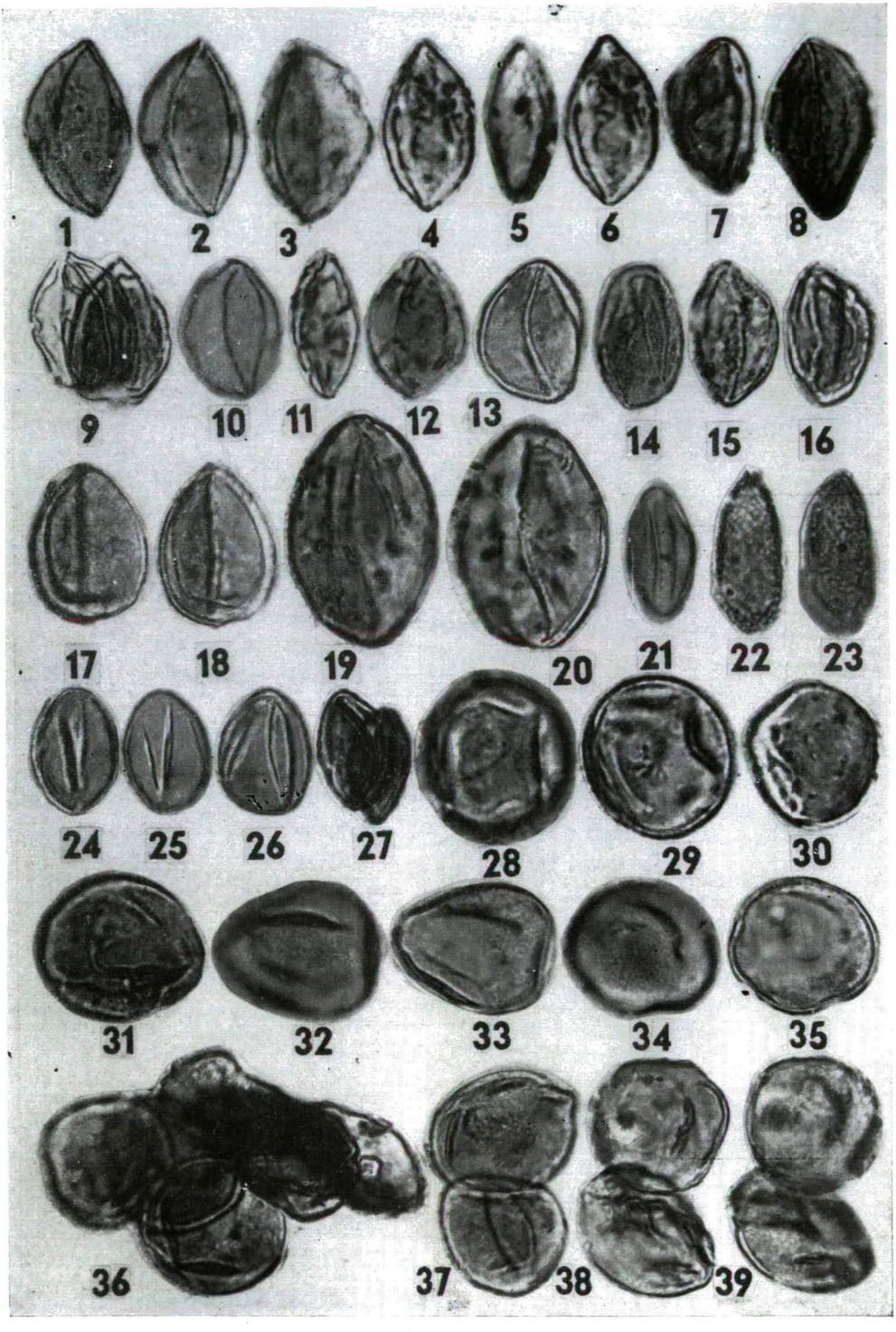
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39

Plate VII.

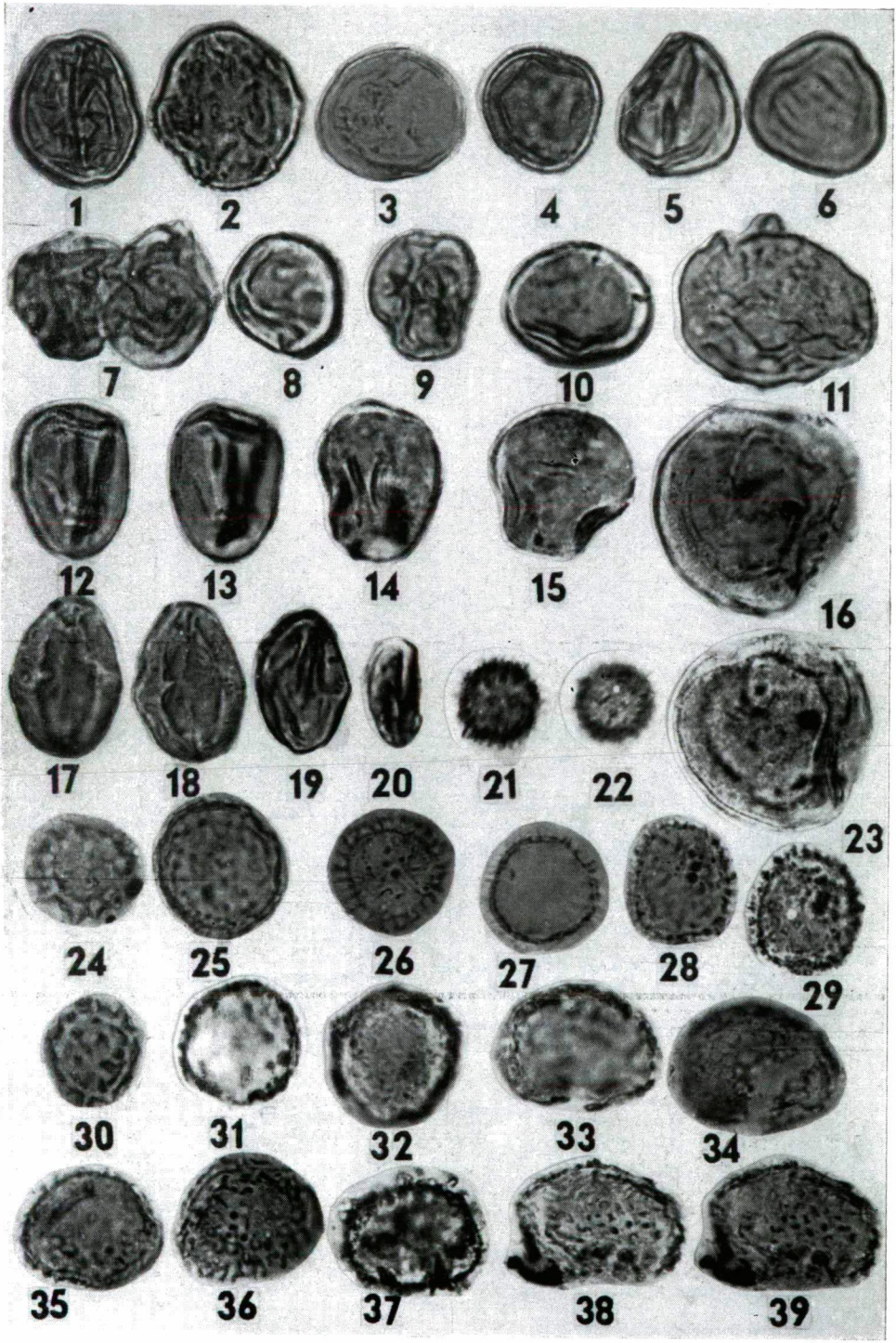
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39

Plate VIII.

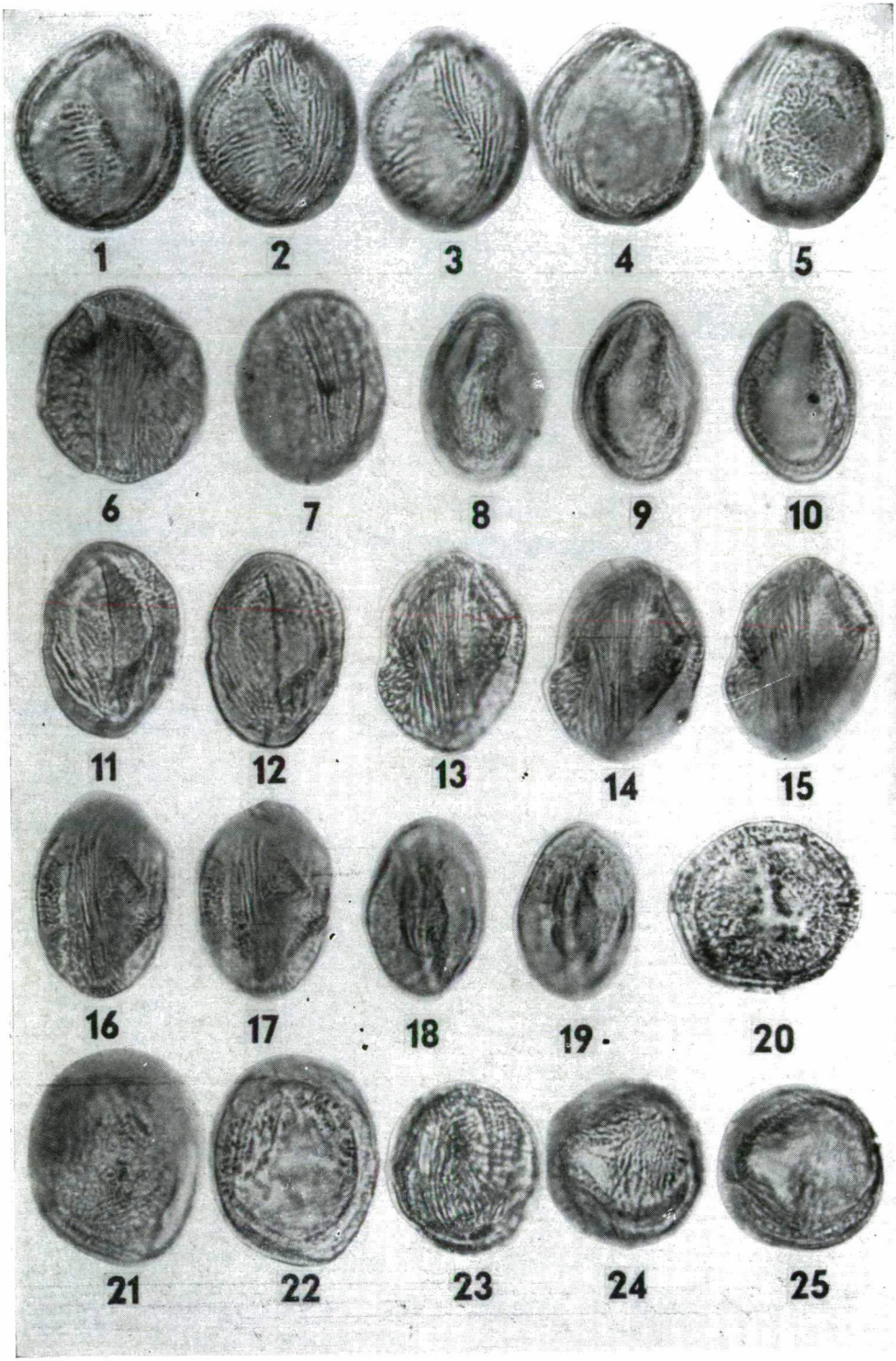

Plate IX.

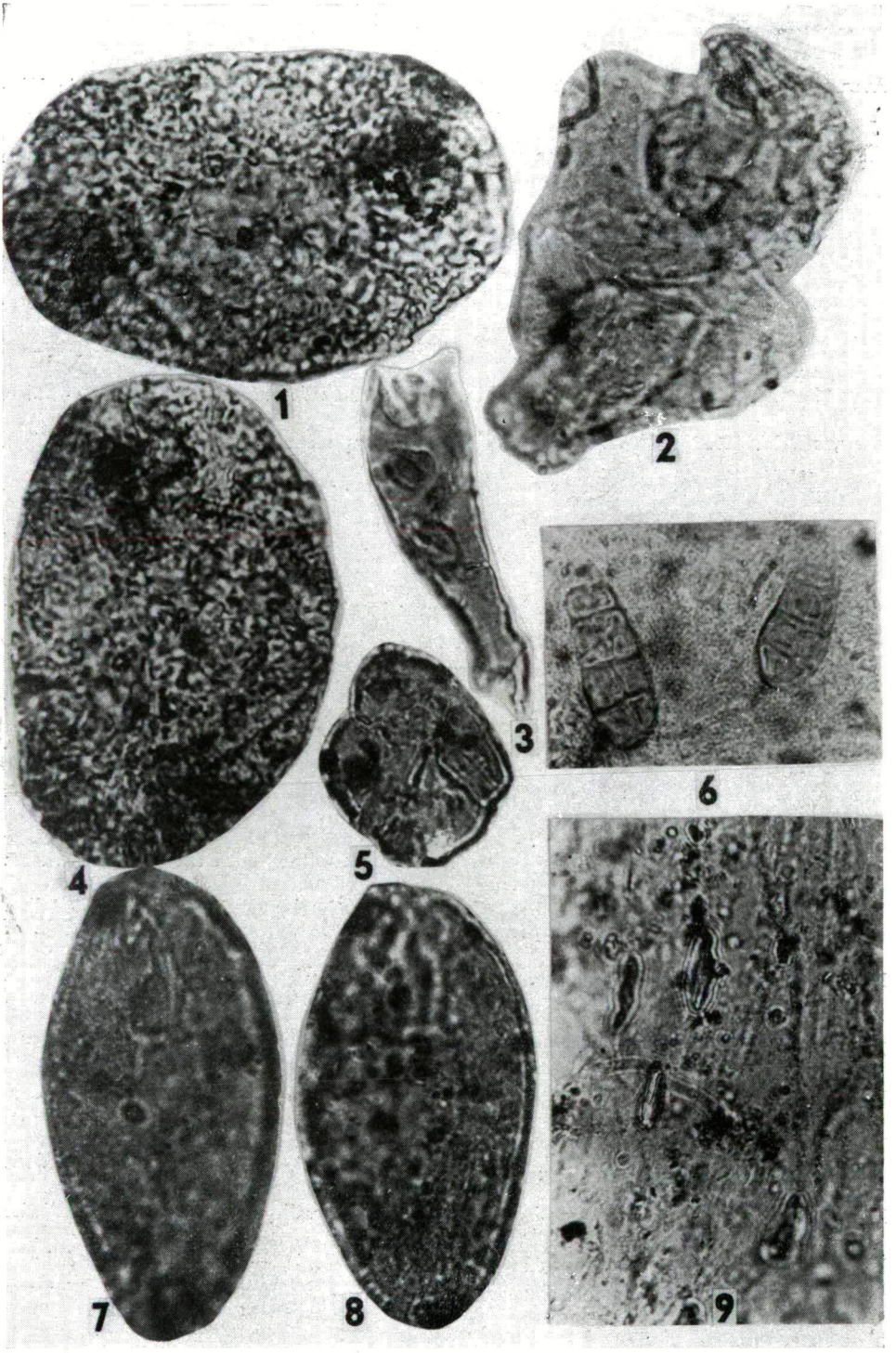

Plate X.

REFERENCES

AVERDIECK, R. [1958]: Pollen vom Chenopodiaceen-Typ im Flöz Frimmersdorf — ein Hinweis auf seine strandnahe Entstehung. — Fortschr. Geol. Rheinld. u. Westf. 1. 101—112.

BRELIE, G. VON DER [1958]: Sporen und Pollen im marinen Tertiär der Niederrheinischen Bucht. — Forschr. Geol. Rheinld. u. Westf. 1. 185—204.

BREILE, G. VON DER und WOLTERS, R. [1958]: Das Alttertiär von Gürzenich. — Fortschr. Geol. Rheinld. u. Westf. 2. 473—477.

COOKSON, I., C. and S. MANUM (1960): On Crassosphaera, a New Genus of Microfossils from Mesozoic and Tertiary Deposits. — Nytt Magasin for Botanikk. 8. 5—8.

COUPER, R., A. [1955]: Supposedly Colpate Pollen Grains from the Jurassic. — Geol. Mag. 92. 471—475.

COUPER, R., A. [1958]: British mesozoic Microspores and Pollen Grains. — Palaentographica, B. 103. 75—179.

CSEH NÉMETH, J. [1958]: Les facies du gisement de minerai de manganese d'Urkut. — Földt. Közl. 88. 399—415.

DEÁK, H., M. [1959]: Observations concernant le changement de forme des spores trilètes. Rev. de Micropaléont. 2. 28—30.

DEFLANDRE, G. [1947]: Le Problème des Hystrichosphères. — Bull. de l'Inst. Océanographique. 918. 1—23.

ERDTMAN, G. [1952]: Pollen morphology and Plant Taxonomy — Angiosperms (An Introduction to Palynology. I.). Almqvist & Wiksell, Stockholm.

GÓCZÁN, F. [1956]: Pollenanalytische (palynologische) Untersuchungen zur Identifizierung der liassischen Schwarzkohlenflöze von Komló. — A M. Áll. Földt. Int. Évkönyve. 45. 167—212.

GRASSELLY, GY. and E. KLIVÉNYI [1960]: Data on the phosphorus content and organic remains of manganese oxide ores from Urkut. — Acta Miner. Petr. Szeged. 13. 3—8.

GROOT, J., J. and J. S. PENNY [1960]: Plant microfossils and age nonmarine Cretaceous sediments of Maryland and Delaware. — Micropaleontology. 6. 225—236.

KEDVES, M. [1960]: Études palynologiques dans le bassin de Dorog,—I. — Pollen & Spores. 2. 89—118.

KEDVES, M. [1961]: Études palynologiques dans le bassin de Dorog, —II—. — Pollen & Spores. 3. 101—153.

KEDVES, [1961]: Beobachtungen an den Pollen des rezenten Ginkgo biloba L. mit besonderer Hinsicht auf die Fragen der Determination der fossilen Pollen der Ginkgoinae. Acta Biol. Szeged. 7. 31—37.

KREMP, G. O. W., H. T. AMES and HILDE GREBE [1957]: Catalog of Fossil Spores and Pollen. 2. Mesozoic and Tertiary Spores and Pollen. — Pal. Lab. Dep. of Geol., Coll. of Miner. Industr.

KREMP, G. O. W., H. T. AMES and A. J. KOVAR [1958]: Catalog of Fossil Spores and Pollen. 4. Cretaceous and Tertiary Spores and Pollen. — Pal. Lab. Dep. of Geol., Coll. of Miner. Industr.

KRUTZSCH, W. [1959]: Mikropaläontologische (sporenpaläontologische) Untersuchungen in der Braunkohle des Geiseltales. — Geologie. 8. 1—425.

LANTZ, J. [1958]: Étude des spores et pollens d'un échantillon purbeckien de l'Ile d'Oléron. — Rev. de Micropal. 1. 33—37.

LANTZ, J. [1958]: Étude palynologique de quelques échantillons mésozoiques du Dorset (Grand-Bretagne). — Rev. de l'Inst. Francais du Pétrole et Ann. des Combustibles Liquides. 13. 917—943.

MACKO, ST. [1957]: Lower Miocene Pollen Flora from the valley of Klodnica Near Gliwice (Upper Silesia). — Trav. de la Soc. des Sc. et des Lettres de Wroclaw. 88. 1—312.

MATTHES, H. W. [1956]: Einführung in die Mikropaläontologie. — S. Hirzel Verlag Leipzig.

NOSZKY, J., IFJ. [1952]: A bakonyi mangánérc rétegtani helyzete és kutatási kilátásai. — MTA. Műsz. Tud. Oszt. Közl. 5.

PACLTOVÁ, B. [1960]: Rostlinné mikrofosilie (hlavne sporomorfy) z lignitovych lozisek u Mydlovar v Ceskobudejovické pánvi. — Sbornik UUG. 25. 109—176.

PACLTOVÁ, B. [1961]: Nekteré roslinné mikrofosilie ze sladkovodnich ulozenin svrchni kridy (senon) v jihoceskych pánvich. — Sbornik UUG. 26. 47—102.

PFLUG, H. D. [1953]: Zur Entstehung und Entwicklung des angiospermiden Pollens in der Erdgeschichte. — Palaeontographica B, 95. 60—171.

ROGALSKA, M. [1954]: Spore and pollen analysis of the liassic coal of Blanowice in Upper-Silesia. — Inst. Geol. 89. 1—46.

REISSINGER, A. [1950]: Die „Pollenanalyse" ausgedehnt auf alle Sedimentgesteine der Geologischen Vergangenheit. — Palaeontographica, B. 99—126.

STIX, E. [1960]: Pollenmorphologische Untersuchungen an Compositen. — Grana Palynologica, 2. 41—104.

SZABÓ—DRUBINA, M.: [1957]: Caractère géologique et minéralogique sédimentaire des minerais de manganèse de la Hongrie. — Földt. Közl. 87. 261—273.

THOMSON, P. W. und H. PFLUG [1953]: Pollen und Sporen des mitteleuropäischen Tertiärs. — Palaeontographica, B. 94. 1—138.

VADÁSZ, E. [1952]: A bakonyi mangánképződés. — MTA. Műsz. Tud. Oszt. Közl. 5.

VALENSI, L. [1953]: Microfossiles des silex du Jurassique moyen. — Mém. de la soc. Géol. de France. 32. 1—100.

WANG, F., H. [1960]: Pollen grains of China. (en chinois) Peking.